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Thomas W. Adams  
Renner, Otto, Boisselle, & Sklar, LLP  
Nineteenth Floor  
1621 Euclid Avenue  
Cleveland, OH 44115

EXAMINER

LEHNER, WILLIAM P

ART UNIT	PAPER NUMBER
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2671

8

DATE MAILED: 04/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/022,133

Applicant(s)

CORBETTA, MARCO

Examiner

William P Lehner

Art Unit

2671

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 1/23/04.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1--22 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 December 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>4</u> . | 6) <input type="checkbox"/> Other: _____  |

**DETAILED ACTION**

***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-3 and 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Frazier (1) "Index Cube Shadow Mapping in OpenGL," in view of Frazier (2) "Real-Time Per-Pixel Point Lights and Spot Lights in OpenGL," in further view of Frazier (3) "Advanced Real-Time Per-Pixel Lighting in OpenGL," in further view of Kato (5999185), in further view of Kilgard "Improving Shadows and Reflections via the Stencil Buffer," and in further view of Foran (5742749).

3. In regard to claim 1, note in Frazier (1) the method of creating shadows (page 1, line 2). Frazier does not create soft shadows. Kato creates soft shadows because they appear natural (column 6, lines 18-33). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1) to create soft shadows as taught by Kato because they appear natural.

4. Frazier (1) has shadow volumes (page 1, line 2). Volumes and cubes imply a 3D scene. Polygons cast shadows on other polygons (page 1, lines 12-13).

5. Frazier (1) does not compute soft shadow edges from edges casting shadows. Kato's FIG. 66 demonstrates soft shadow edges on shadow polygon 425 from edges

casting shadows from cube 420 because this is used to create the soft shadow.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1) to compute soft shadow edges from edges casting shadows as taught by Kato because this is used to create soft shadows.

6. Frazier (1) creates six faces of a cube map representing a cube centered at the light source (page 1, line 31). Although this paper does not say the cube is aligned with orthogonal major axes, it is expressed in Frazier (2) (page 11, lines 10-12).

7. Frazier (1) shows the scene rendered on all six faces of the cube with full brightness and color (page 2, FIG. 1 and lines 1-5). As mentioned above, Kato teaches rendering soft shadows using edges casting shadows and computing soft shadow edges.

8. From the point of view of the viewer, Frazier (1) computes the distance or depth from the camera to polygon pixels (page 1, lines 14-15). Although this paper does not say this depth is stored in a z-buffer or depth-buffer, it is expressed in Frazier (3) (page 13, line 5).

9. Frazier (1, 2, 3) and Kato do not render the scene into the z-buffer with the light, colors, and textures disabled. Kilgard provides code to perform this depth test with the lighting disabled and colors not updated because it saves time (page 26 line 8 and page 27 comment in line 2). Kilgard does not bother with lighting and colors because they are appearance-related and not necessary to determine z-values; texture is also appearance-related and not necessary. Therefore, it would have been obvious to one of

ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3) and Kato to disable lighting, colors, and textures as taught by Kilgard because it saves time.

10. Frazier (1) renders shadow volumes into a stencil buffer (page 11, lines 10-12) in combination with the depth-buffer information (page 13, lines 4-7).

11. Frazier (1, 2, 3), Kato, and Kilgard render the full scene, apply a cube map for rendering soft shadows, and use a stencil test to prevent the scene to be drawn in shadowed areas, but use depth coordinates instead of texture coordinates in the stencil test. Foran teaches that depth coordinates are generated as if they were texture coordinates (column 11, lines 10-25) because these coordinates can be converted from light coordinates and project the texture map into the scene being rendered (column 7, line 60 – column 8, line 3). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, and Kilgard to use texture coordinates as taught by Foran because they can be converted from light coordinates and project the texture map into the rendered scene.

12. Frazier (1, 2, 3), Kato, and Kilgard do not perform the shadow test and render the scene in one pass. Foran teaches that the shadow test pass and the pass that draws the scene with full illumination can be combined into a single pass (column 10, line 59 – column 11, line 6) because this would be faster. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, and Kilgard to combine the shadow testing pass and rendering pass as taught by Foran because it would be faster.

13. In regard to claims 2 and 12, Frazier (3) says that color 1 and color 2 contain alpha values and they are blended (page 1, lines 19-41). Again, Kato teaches that the shadow casting edges are used to compute the soft shadow edges.

14. In regard to claims 3 and 13, Frazier (1) computes shadow polygons but does not create soft shadow polygons that are dark on one edge and bright on another. Kato teaches that the interior of the basic shadow polygon and the boundary between the basic shadow polygon and detailed shadow polygons have a concentration gradation of 1 (full ambient darkness). The outer contour of the detailed shadow polygons and triangles have a concentration gradation of 0 (full ambient brightness). The concentrations of the regions in between are linearly interpreted because this creates a soft shadow that fades from darkness to brightness (column 41, lines 50-62 and FIG. 66). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1) to create soft shadow polygons that are dark on one edge and bright on another as taught by Kato because it would be possible to interpolate between full ambient brightness and full ambient darkness to create a fading soft shadow.

15. In regard to claim 11, note in Frazier (1) code for a computer program (page 3), and the above rejections to claim 1.

16. Claims 4, 5, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Frazier (1) "Index Cube Shadow Mapping in OpenGL," in view of Frazier (2) "Real-Time Per-Pixel Point Lights and Spot Lights in OpenGL," in further

view of Frazier (3) "Advanced Real-Time Per-Pixel Lighting in OpenGL," in further view of Kato (5999185), in further view of Kilgard "Improving Shadows and Reflections via the Stencil Buffer," in further view of Foran (5742749), and in further view of Peercy (5880736). Frazier (1, 2, 3) does not compute vertices of additional shadow polygons. Kato generates soft shadow polygon vertices from a vector extending outward by a predetermined distance  $\delta$  (column 41, lines 43-47). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3) to generate soft shadow polygon vertices by extending outward along a vector by a predetermined distance  $\delta$  as taught by Kato because this creates additional soft shadow polygons.

17. Frazier (1, 2, 3), Kato, Kilgard, and Foran do not compute a vector given by a cross product between a normalized vector along shadow casting edges and a surface normal. Peercy calculates a cross product between a shading vector and a normal at the surface to determine how the surface is shadowed (column 5, lines 25-31).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, Kilgard, and Foran to calculate a cross product between a normalized vector along shadow casting edges and a surface normal as taught by Peercy because this determines how the surface is shadowed.

18. Claims 6, 7, 9, 10, 16, 17, 19-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Frazier (1) "Index Cube Shadow Mapping in OpenGL," in view of Frazier (2) "Real-Time Per-Pixel Point Lights and Spot Lights in OpenGL," in further

view of Frazier (3) "Advanced Real-Time Per-Pixel Lighting in OpenGL," in further view of Kato (5999185), in further view of Kilgard "Improving Shadows and Reflections via the Stencil Buffer," in further view of Foran (5742749), and in further view of Snyder (6252608).

19. In regard to claims 6 and 16, in Frazier (3), note "real-time" in the title. Also, frustums, or views of the cube map need to be rebuilt or updated because of movement by objects or light (page 13, lines 15-17). Frazier (1, 2, 3), Kato, Kilgard, and Foran do not require an update for a change in the viewer's position, direction of view, or field of view. Snyder requires an update for viewpoint movement (column 12, line 33) because viewpoint movement changes the scene. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, and Kilgard to require an update for a change in position of the viewer, direction of view, or field of view as taught by Snyder because viewpoint movement changes the scene.

20. In regard to claims 7 and 17, Frazier (1, 2, 3) and Kato do not say that they clear the stencil buffer. Kilgard clears the stencil buffer (page 25, line 20) because if it was not cleared at the beginning it may contain an incorrect value. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3) and Kato to clear the stencil buffer as taught by Kilgard because it prevents errors.

21. Frazier (1, 2, 3) and Kato do not say they performs a per-pixel stencil operation, increase a value in the stencil buffer for front-facing polygons if the depth of the shadow



volume polygon is less than the depth stored in the z-buffer, and decrease the stencil buffer for back-facing polygons if passing a depth test. Kilgard performs a per-pixel stencil operation, increments the stencil buffer for front-facing polygons, and decrements the stencil buffer for back-facing polygons (comments on page 36) because this creates shadow volumes. This depth test passes when a rendered pixel is closer than the value in the depth buffer (page 27, lines 1-5). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3) and Kato to perform a per-pixel stencil operation, increase a value in the stencil buffer for front-facing polygons if the depth of the shadow volume polygon is less than the depth stored in the z-buffer, and decrease the stencil buffer for back-facing polygons if the depth of the pixel is less than the value in the depth buffer as taught by Kilgard because this creates a shadow volume.

22. In regard to claims 9 and 19, Frazier (3) has multiple lights (page 1, line 22). Because the cube map only has one origin at the position of the light source, multiple light sources mean multiple cube maps.

23. In regard to claims 10 and 20, Frazier (1, 2, 3), Kato, Kilgard, and Foran do not have characteristic points of shadows, frames of animation, and threshold values. Snyder teaches frames of animation, storing the location of characteristic points of shadows, and re-rendering shadows if the difference of the characteristic points between subsequent frames exceeds a threshold value, because this evaluates the accuracy of the shadow map for re-use (column 88, line 57 – column 89, line 2). Therefore, it would have been obvious to one of ordinary skill in the art at the time the

invention was made to modify Frazier (1, 2, 3), Kato, Kilgard, and Foran to have characteristic points of shadows, frames of animation, and threshold values as taught by Snyder because this evaluates the accuracy of the shadow map for re-use.

24. In regard to claim 21, Frazier (3) has a color buffer that stores color values (page 1, line 33), a depth buffer that stores depth values (page 3, lines 36-37), and a stencil buffer for storing stencil mask information (page 11, line 2).

25. Frazier (1, 2, 3), Kato, Kilgard, and Foran do not say they have texture memory, a rasterizer, or pixel engines. Snyder has a rasterizer in communication with a pixel engine (FIG. 4B, elements 464 and 466), a pixel engine includes the z-buffer and stencil buffer for each pixel (column 19, lines 30-42), and a tiler containing and communicating with a texture memory and a pixel engine (FIG. 9B, elements 378, 402, and 406) because they perform the depth test, stencil test, and other operations necessary for the invention. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, Kilgard, and Foran to have a rasterizer, pixel engine, texture memory in communication with each other as taught by Snyder because they perform the operations necessary for the invention.

26. In regard to claim 22, Frazier (3) has an alpha buffer to bump the display to 32 bits (page 1, lines 23-24).

27. Claims 8 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Frazier (1) "Index Cube Shadow Mapping in OpenGL," in view of Frazier (2) "Real-Time Per-Pixel Point Lights and Spot Lights in OpenGL," in further view of Frazier (3)

"Advanced Real-Time Per-Pixel Lighting in OpenGL," in further view of Kato (5999185), in further view of Kilgard "Improving Shadows and Reflections via the Stencil Buffer," in further view of Foran (5742749), in further view of Snyder (6252608), and in further view of Dietrich "Cube Maps". Frazier's stencil buffer rejects pixels based on the value in the stencil buffer ("Advanced Real-Time Per-Pixel Point Lights and Spot Lights in OpenGL," page 11, lines 4-6).

28. Frazier (1, 2, 3), Kato, Kilgard, and Foran do not say they access the cube map faces by the greatest magnitude coordinate and select texels by the other two components. Dietrich accesses the cube map faces by the greatest magnitude coordinate and selects texels by the other two components (page 3) because this is a simple way of accessing faces and selecting texels. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Frazier (1, 2, 3), Kato, Kilgard, and Foran to access the cube map faces by the greatest magnitude coordinate and select texels by the other two components as taught by Dietrich because it is simple.

### ***Response to Arguments***

1. Applicants argues on page 2, lines 10-22 that obviousness is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references

individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

2. Applicant argues on page 2, line 23 – page 3, line 14 that motivation is lacking to combine references. Motivation was not given to combine the three Frazier references because they have the same author, topic of rendering light using cubemaps, and were found on the same website. They are continuations of each other and have links to the previous articles (Frazier (1) “Index Cube Shadow Mapping in OpenGL”, page 1, line 1 and Frazier (3) “Advanced Real-Time Per-Pixel Lighting in OpenGL” page 1, line 1). The following motivations for combining references were present in the first Office Action:

3. Motivation was given to modify Frazier with Kato’s soft shadows because they appear natural (Kato, column 6, lines 18-33). The Kato reference is actually not needed because Frazier’s diffuse lighting creates soft shadows shown at least at Frazier (3) page 2, line 32 – page 5. Note the pictures of soft shadows on page 4, 5, 7, 8, 17 of Frazier (3).

4. Motivation was given to modify Frazier with Kilgard’s rendering with light, colors, and textures disabled because it saves time (Kilgard, page 26 line 8 and page 27 comment in line 2).

5. Motivation was given to modify Frazier with Foran to use texture coordinates instead of depth coordinates because these coordinates can be easily converted from light coordinates and projected the texture map into the scene being rendered (Foran, column 11, lines 10-25 and column 7, line 60 – column 8, line 3).

6. Motivation was given to modify Frazier with Peercy to calculate a cross product between a shading vector and a normal at the surface because this determines a shading value for the pixels on the object surface (Peercy, column 5, lines 25-31).

7. Motivation was given to modify Frazier with Snyder to require an update for viewpoint movement because the viewpoint movement changes the scene (Snyder, column 12, line 33).

8. Applicant argues on page 3, lines 15-24 and page 5, line 27 – page 6, line 10 that it was not shown how the references were combined, merely similarities in the prior art were found, hindsight reasoning was improperly applied, and motivations are lacking. Motivations showing how the references were combined were in the first Office Action and are repeated above. Similar prior art shows that the present invention is not novel. In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

9. Applicant argues on page 3, line 25 – page 4, line 9 that the number of references, their possible combination elements, and the number of pages in the Office Action was excessive. The number of elements in the references was needed because

of the many elements in the claims. The amount of pages taken to explain is immaterial. In response to applicant's argument that the examiner has combined an excessive number of references, reliance on a large number of references in a rejection does not, without more, weigh against the obviousness of the claimed invention. See *In re Gorman*, 933 F.2d 982, 18 USPQ2d 1885 (Fed. Cir. 1991).

10. Applicant argues on page 4, line 26 - page 5, line 3 and page 5, lines 23-26 that Kato and Frazier cannot be combined because they have fundamentally different purposes. Applicant's purpose is rendering soft shadows. Frazier's purpose is rendering shadows (Frazier (1) page 1, line 2). The fact that index mapping of Frazier (1) is different from applicant's depth mapping does not matter because Frazier (3) also uses depth mapping (Frazier (3) page 13, line 2). A recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963).

11. Applicant argues on page 5, lines 4-22 that Kato can only project shadows onto a ground plane. The Kato reference is actually not needed because Frazier draws soft shadows. Note the pictures on page 4, 5, 7, 8, 17 of Frazier (3) where soft shadows are projected onto the ground plane, walls, ceiling, and a cube. A shadow is also drawn on the inside of a tire (Frazier (1), page 5).

12. Applicant argues on page 6, lines 10-16 that one skilled in the art would not use Frazier because he confesses that it uses too much video memory and thus has deficient performance. In the art, more memory is always desirable and video cards have increased their memory to 128 or 256 MB. Frazier does not say that this deficiency is so drastic that it is unusable. Frazier himself created a first person shooter game as described at <http://www.ronfrazier.net/apparition/>. This game was designed using cubemaps and was intended to run on hardware commonly available in the year 2000, such as the GeForce 2 video card with only 64MB. Click on the Research Projects link to find where the Frazier references with vivid pictures are located.

### ***Conclusion***

13. Applicant's arguments filed 1/23/01 have been fully considered but they are not persuasive. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

29. A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

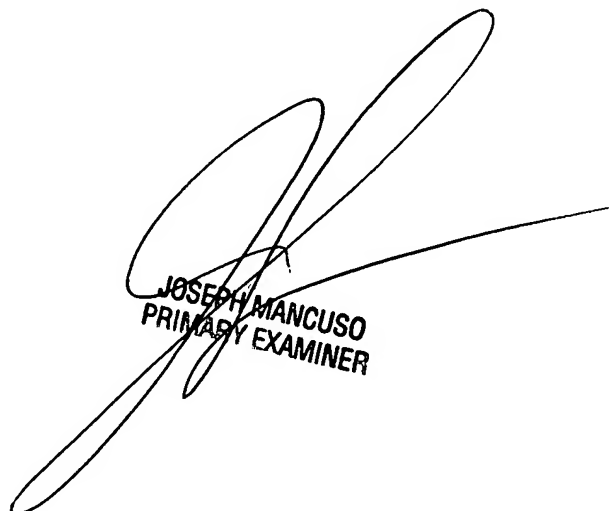
the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

30. Any inquiry concerning this communication or earlier communications from the examiner should be directed to William P Lehner whose telephone number is 703-305-0682. The examiner can normally be reached on 8:30 - 5 M-F.

31. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Zimmerman can be reached on 703-305-9798. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

32. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-306-0377.

WPL



JOSEPH MANCUSO  
PRIMARY EXAMINER